National Security Space Office

Barriers to Entry and Sustainability in the US Space Industry

Findings

Outline

- Problem Statement
- Problem Rationale
- Study Approach
- Data Collection
- Survey Respondent Characteristics
- Findings & Recommendations

Problem Statement

Purposes of this study:

- Respond to task from the Deputy Assistant Secretary of Defense/Strategic Capabilities
- Develop insight and understanding concerning potential *barriers to entry and sustainability* in the space industry
- Transition from anecdotal to empirical basis
- Report suggested remedies

Problem Rationale

DoD/IC policies and practices can create barriers, which in turn aggravate already challenging market conditions

– *Market Conditions*

- Complexity of operational environment
- High initial investment
- Economies of scale
- Learning curve
- Low production rates
- Switching costs are high
- Access to qualified labor
- Limited operational access for testing/repair/replacement/refuel
- Gov't is significant portion of US space market

– *DoD/IC Policies and Practices*

- Export restrictions
- Access to information on emerging concepts, new projects, requirements, plans
- Administrative restrictions and burdens
- Access to ranges, platforms and other facilities
- Cleared space professionals
- Contract bundling and pricing
- Payment delays
- Funding uncertainties
- Technology constraints

Aspiring entrepreneurs must negotiate both market and government barriers

Problem Rationale cont'd

Market Conditions

- Complexity of operational environment
- High initial investment
- Economies of scale
- Learning curve
- [illegible]
- Switching costs are high
- Access to qualified labor
- Limited operational access for testing/repair/replacement/refuel
- Gov't is approximately half of US market demand

Focus of this study

– DoD/IC Policies and Practices

- Export restrictions
- Access to information on emerging concepts, new projects, requirements, plans
- Administrative restrictions and burdens
- Access to ranges, platforms and other facilities
- Cleared space professionals
- Contract bundling and pricing
- Payment delays
- Funding uncertainties
- Technology constraints

Aspiring entrepreneurs must negotiate both market and government barriers

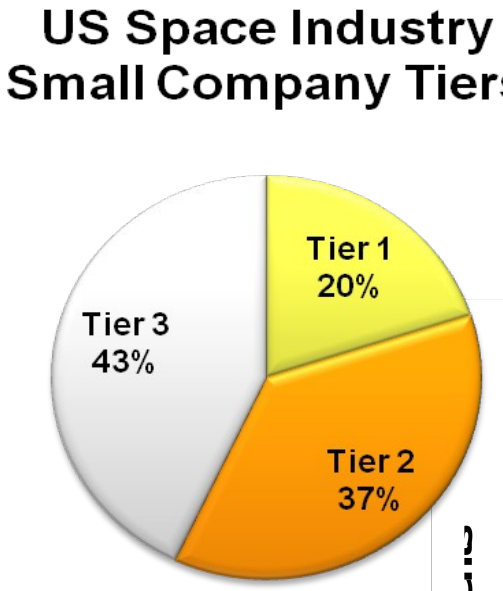
Study Approach

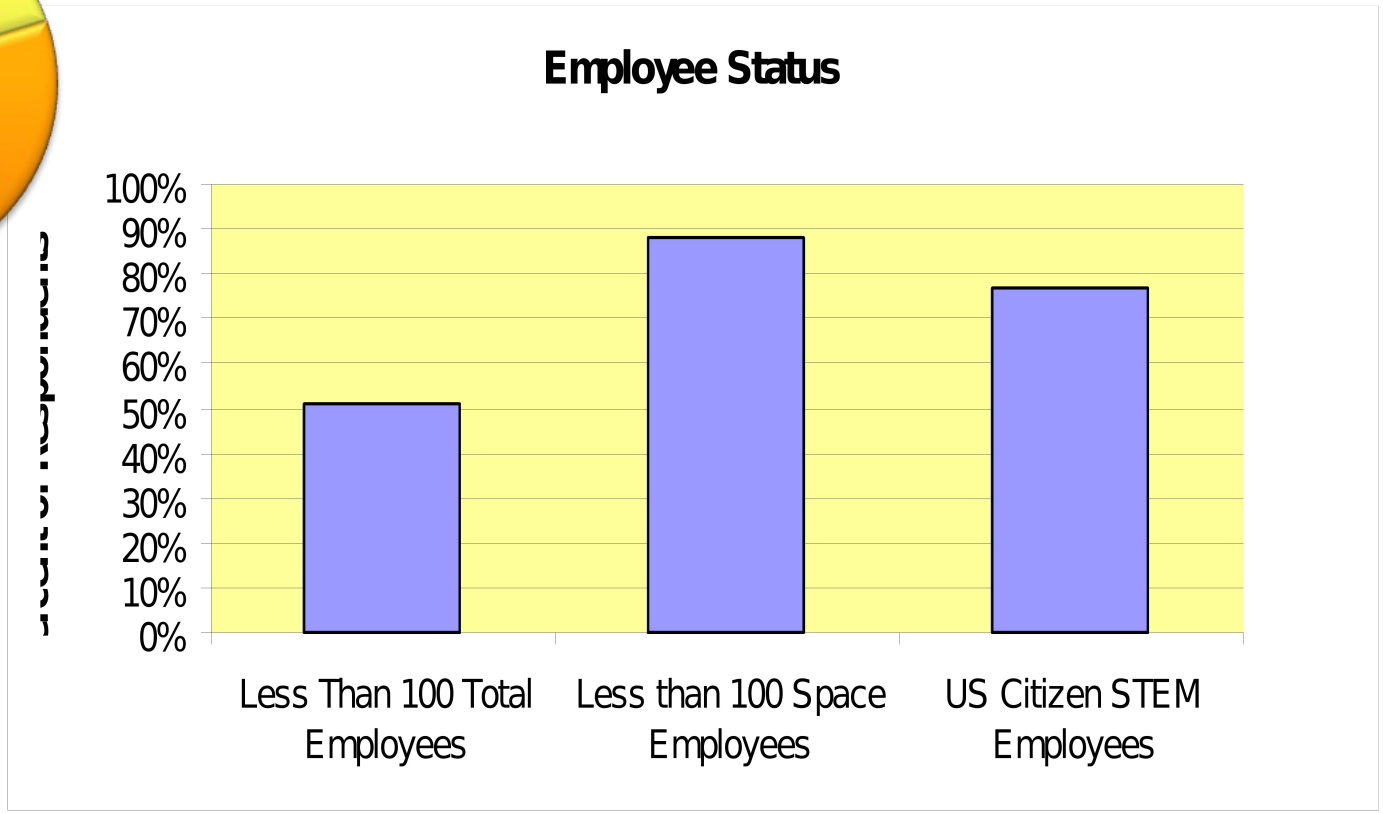
- Top level study tasks
  - Literature review
  - Interview a few small companies in the US Space Industry to identify potential issues for a survey
  - Survey small companies with an interest in the US space industry
  - Analyze survey information to identify issues important to small companies in the US Space Industry
  - Report findings

Data Collection

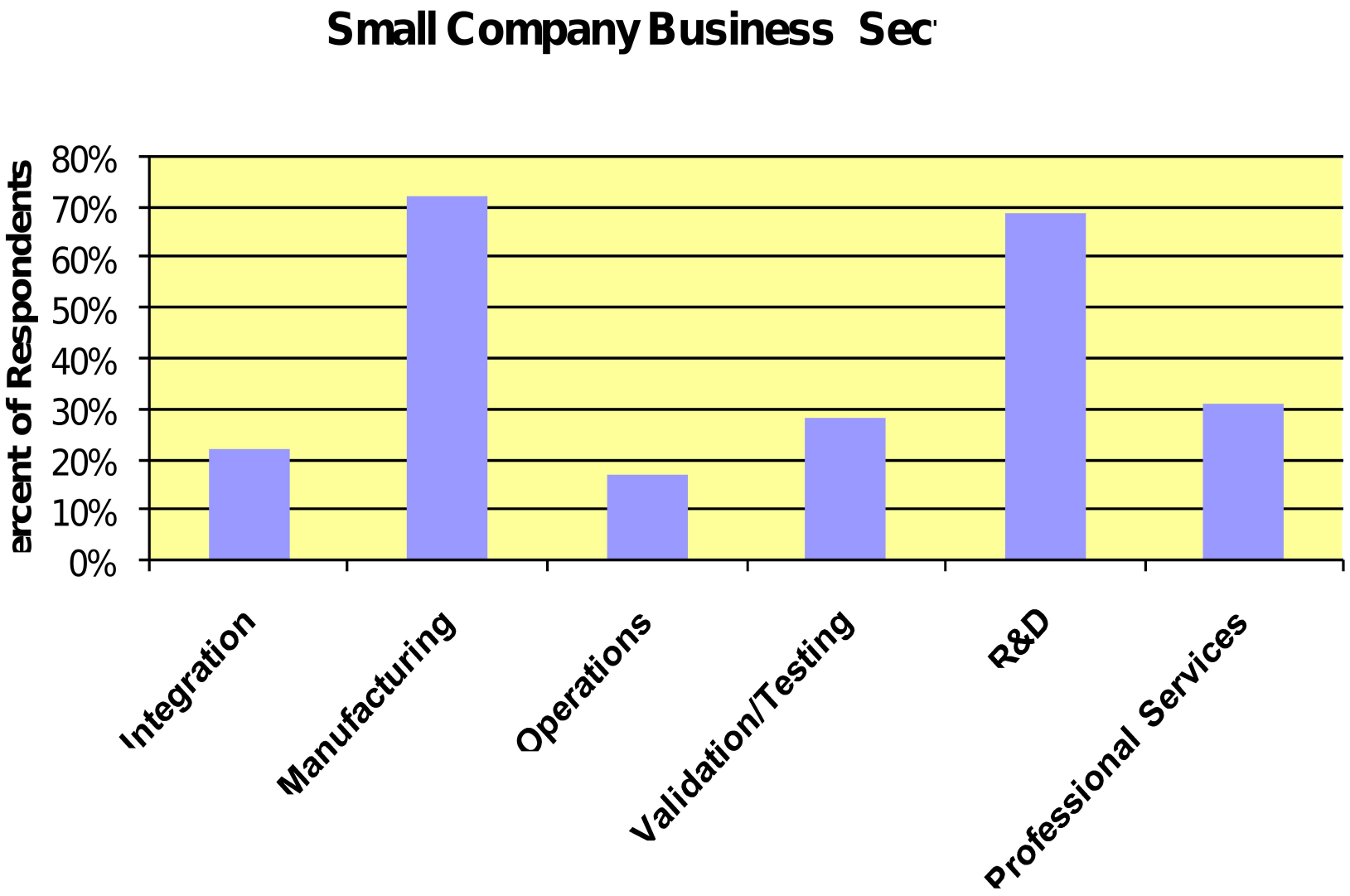
- Literature review completed
- Approximately 200 small company addressees of US Space Industry identified with e-mail addresses
- Small company survey complete
  - Intensive telephone work required to generate responses
  - 38 small company responses (typical response rate for e-mail survey)
    - Adequate to highlight problem areas
    - Data and free-form text
- Aerospace/Economic and Marketing Analysis Center interviewed 20 companies in separate effort
  - Cross-section of Tiers, company size
  - Preliminary results

Survey Respondent Characteristics

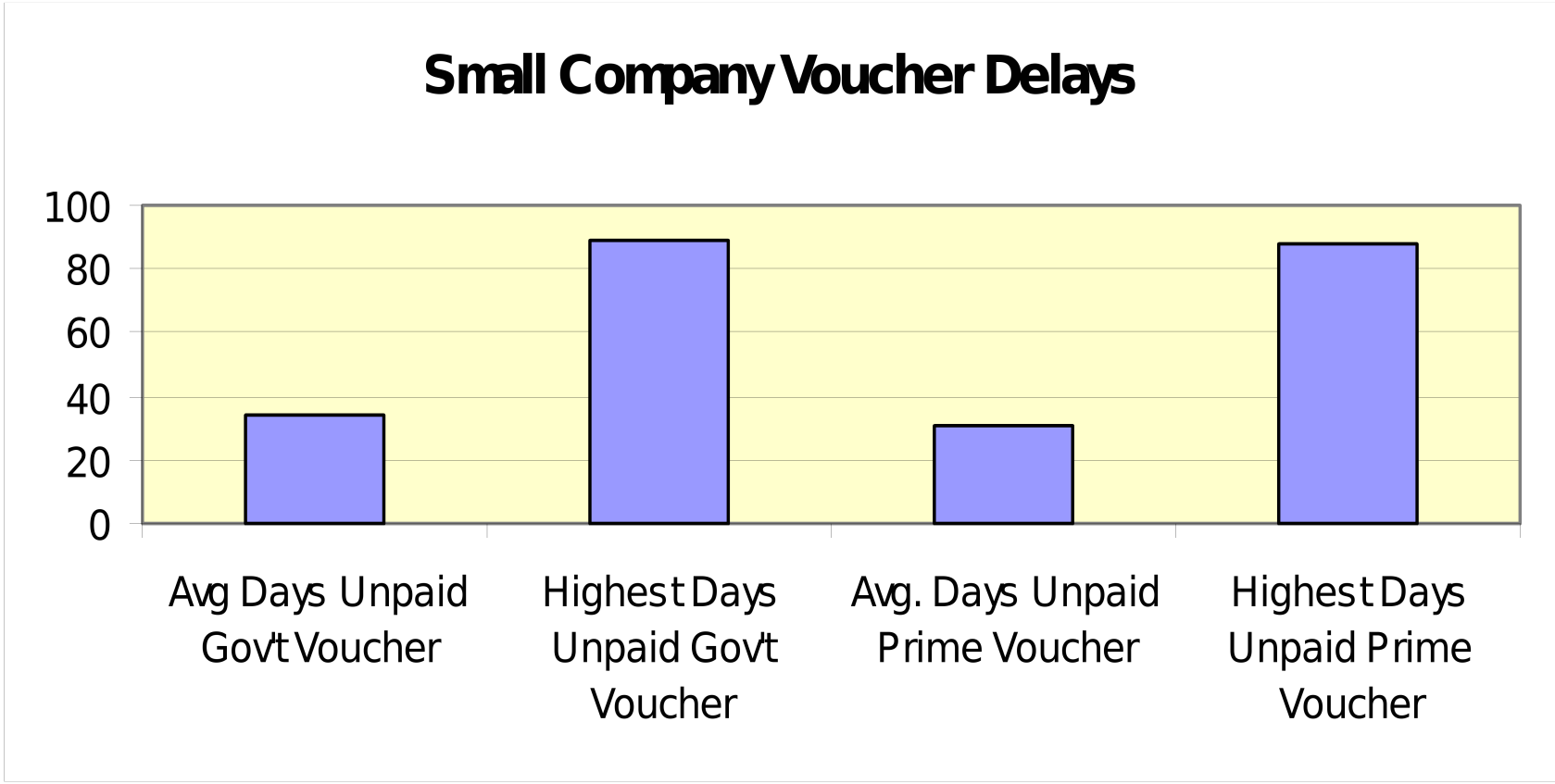




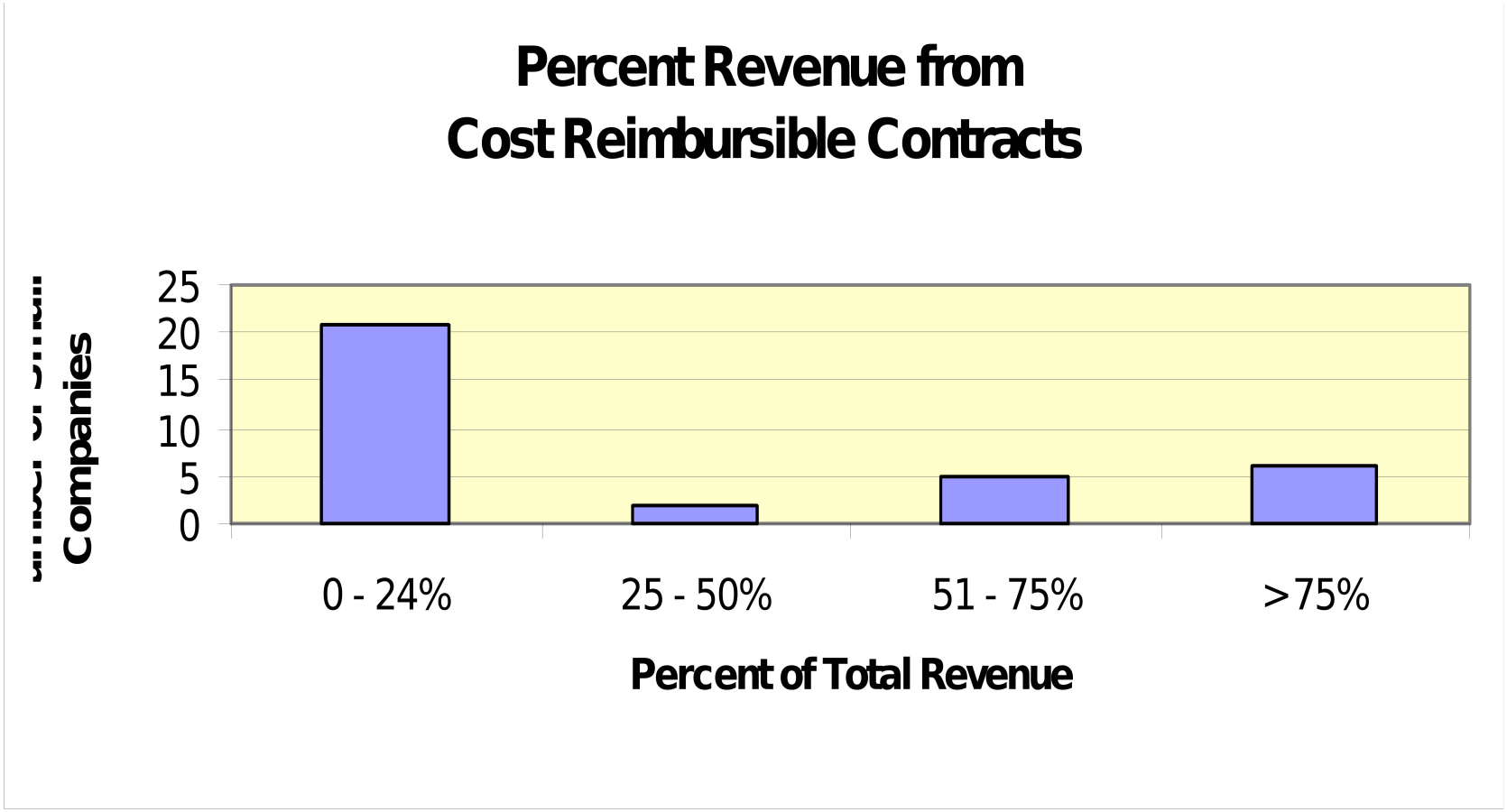
Survey Respondent Characteristics Cont'd



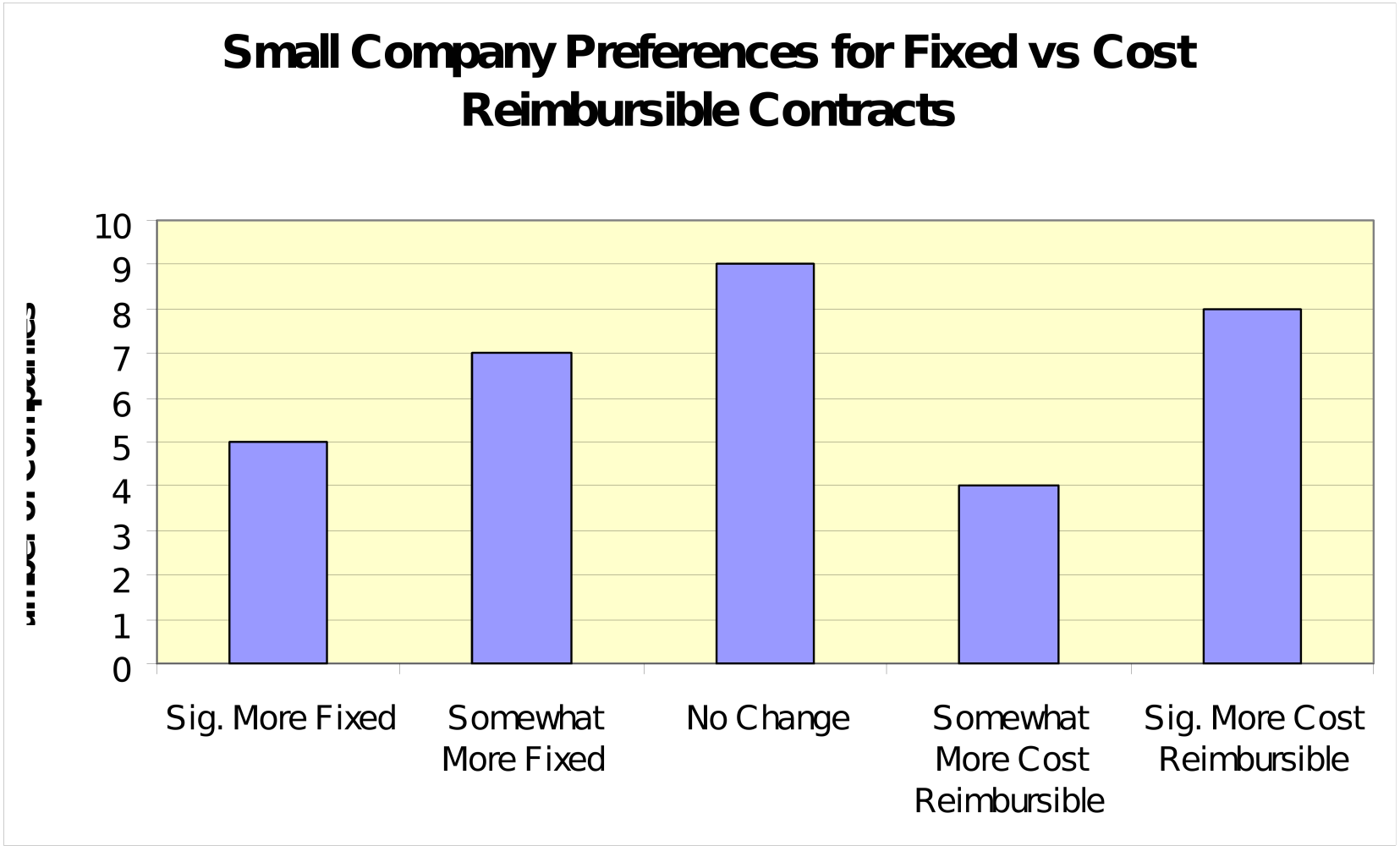
Survey Respondent Characteristics Cont'd



Survey Respondent Characteristics Cont'd



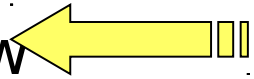
Survey Respondent Characteristics Cont'd



Findings and Recommendations:
Issue Selection Criteria

- Approximately 25% or more of survey respondents indicated the topic is a problem for entry or sustainability
  - More recent entries (<25 years)
  - Smaller companies (<500 employees)
  - Text responses corroborate, clarify
- One or more DOD/IC organizations could accept/be assigned responsibility to consider remedies proposed by respondents

Findings and Recommendations:
Categories of Barriers

- Information Flow 
  - Access to information
  - Cleared space professionals
- Compliance
  - Export control
  - Administrative restrictions and burdens
- Resource Impediments
  - Access to ranges, platforms, facilities
  - Contract bundling and pricing
  - Payment delays
  - Funding uncertainties
  - Technology & STEM constraints

Findings and Recommendations: ***Information Flow Barriers***

- Findings
  - Aspiring entrants typically have:
    - No facility clearance
    - No cleared staff
  - 43% of respondents perceived that they suffered unfairly from restricted access to DoD/IC information
    - Emerging concepts
    - New programs
    - New projects
    - Changing requirements
    - Plans for research and development

Findings and Recommendations: ***Information Flow Barriers***

- Respondent recommendations
  - Security Clearances

E
- Assist smaller companies to extend facility clearance for one year beyond the end of a contract requiring a clearance

M
- Facilitate leased access to cleared/secured office space maintained at ‘collaborative’ locations within each state or region
  - Example: Acquisition Resource Center (NSA)

H
- Provide non-contract billets for two appropriately cleared staff for companies without a current classified contract
  - Requires access to cleared/secured facilities
  - Requires experienced corporate SSO, perhaps mentor
  - Requires annual training

M
- Establish office to provide basic information about clearance processes

E: easy or no $ M: some effort and/or some $ H: Significant effort and/or signi

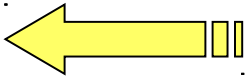
Findings and Recommendations: ***Information Flow Barriers***

- Respondent Recommendations
  - Industry Conferences
    - DoD/IC Program Offices increase the push of information to lower tiers
      - e.g., one or more Industry Day Conferences per year for smaller companies
        - » Different levels of security classification for different programs
      - Explicitly describe technical needs of programs, emerging concepts

Note: additional USG labor, funding needed to implement

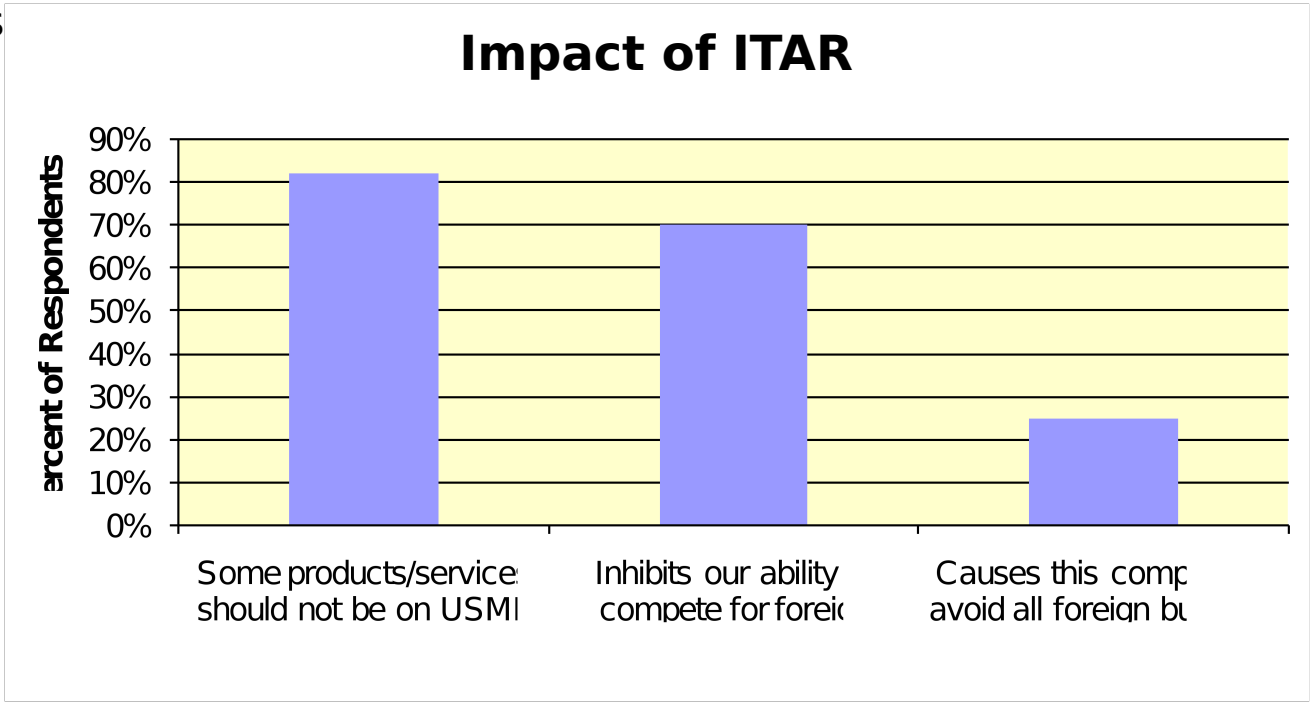
Types of responsible organizations: System Program Offices, National Security Industrial Program, agency security offices, academia, state Governors' offices.

Findings and Recommendations:
Categories of Barriers

- Information Flow
  - Access to information
  - Cleared space professionals
- Compliance 
  - Export control
  - Administrative restrictions and burdens
- Resource Impediments
  - Access to ranges, platforms, facilities
  - Contract bundling and pricing
  - Payment delays
  - Funding uncertainties
  - Technology & STEM constraints

Findings and Recommendations: ***Compliance Barriers***

- Findings



  - High costs of compliance with DCAA cost accounting methods coupled with small contract value and modest profit margins tends to inhibit entry decision as well as sustainability.
  - 30% of respondents perceived there were products which should not have been held to MILSPEC

Findings and Recommendations:
Compliance Barriers

- Respondent recommendations (DCAA Related):

M – Raise contract value threshold subject to DCAA auditing

  - Currently $650,000

E – Ensure companies are aware of the availability of less expensive software packages acceptable to DCAA for small company use

M – Create a DoD/IC organizational element responsible for assisting companies to achieve DCAA compliance through use of web-based resources, training, and advisory activities.

E – Prior to an audit, DCAA provide a preliminary list of audit interests and guidelines on rate and overhead structures typical of the space industry

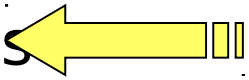
M – Increase the frequency with which DCAA auditors continue assignments to the same companies

Findings and Recommendations:
Compliance Barriers

- Respondent recommendations:
  - **H** – Congress direct a review of space-related items on the USML
  - **M** – Gov’t contract program offices should encourage negotiation and technical interchange:
    - Applicability of MILSPEC among subs, primes, and DoD/IC
    - Early stages of the program after contact award

Types of responsible organizations: DCAA, DCMA, SPOs, Space Quality Improvement Council, Space Suppliers Council, DoD/IC policy offices, Cost Accounting Standards Board

Findings and Recommendations:
Categories of Barriers

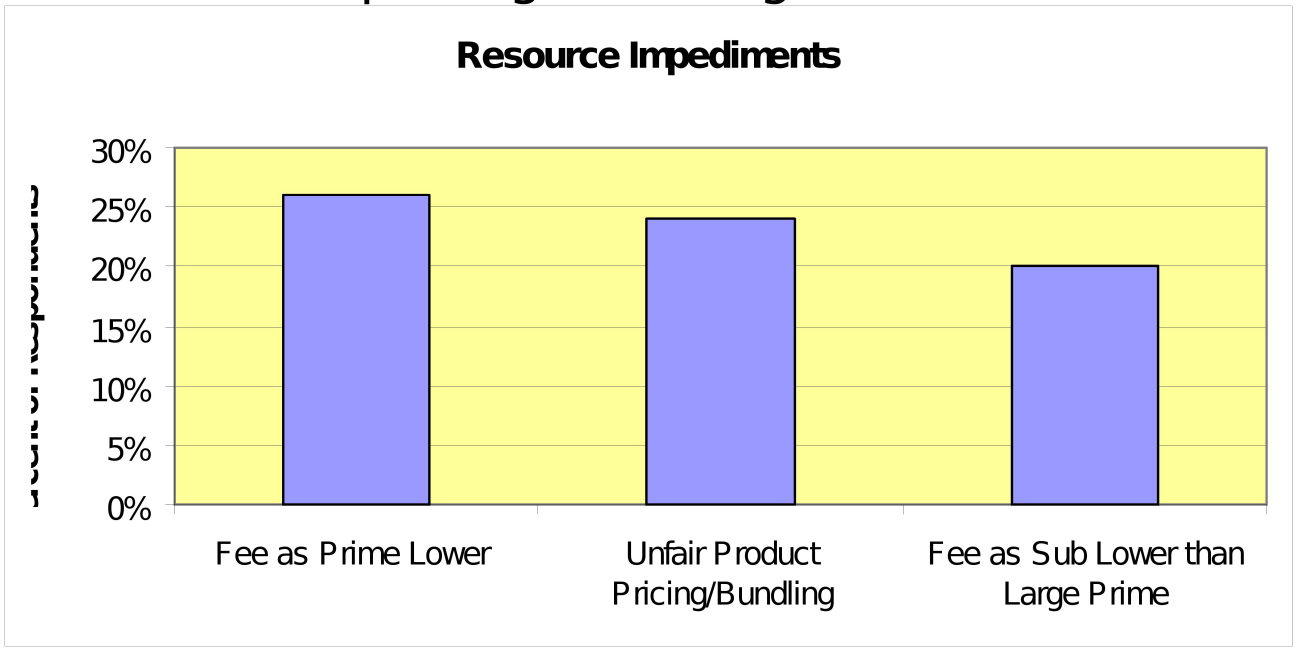
- Information Flow
  - Access to information
  - Cleared space professionals
- Compliance
  - Export control
  - Administrative restrictions and burdens
- Resource Impediments 
  - Access to ranges, platforms, facilities
  - Contract bundling and pricing
  - Payment delays
  - Funding uncertainties
  - Technology & STEM constraints

Findings and Recommendations:
Resource Impediments Barriers

- Findings:
  - Small companies are more vulnerable
    - Fluctuations in Gov’t funding
    - Delays in Gov’t payments
    - Delays in prime to sub payments
  - Small companies rely much more on venture capital, which requires a predictable higher return on investment than internal sources of capital, and which implies a *higher cost of money* for small companies
    - Not chargeable – paid from fee or investment capital
  - Commercial activities can earn high profit in good times, while Gov’t contractors have limited profits to offset business setback

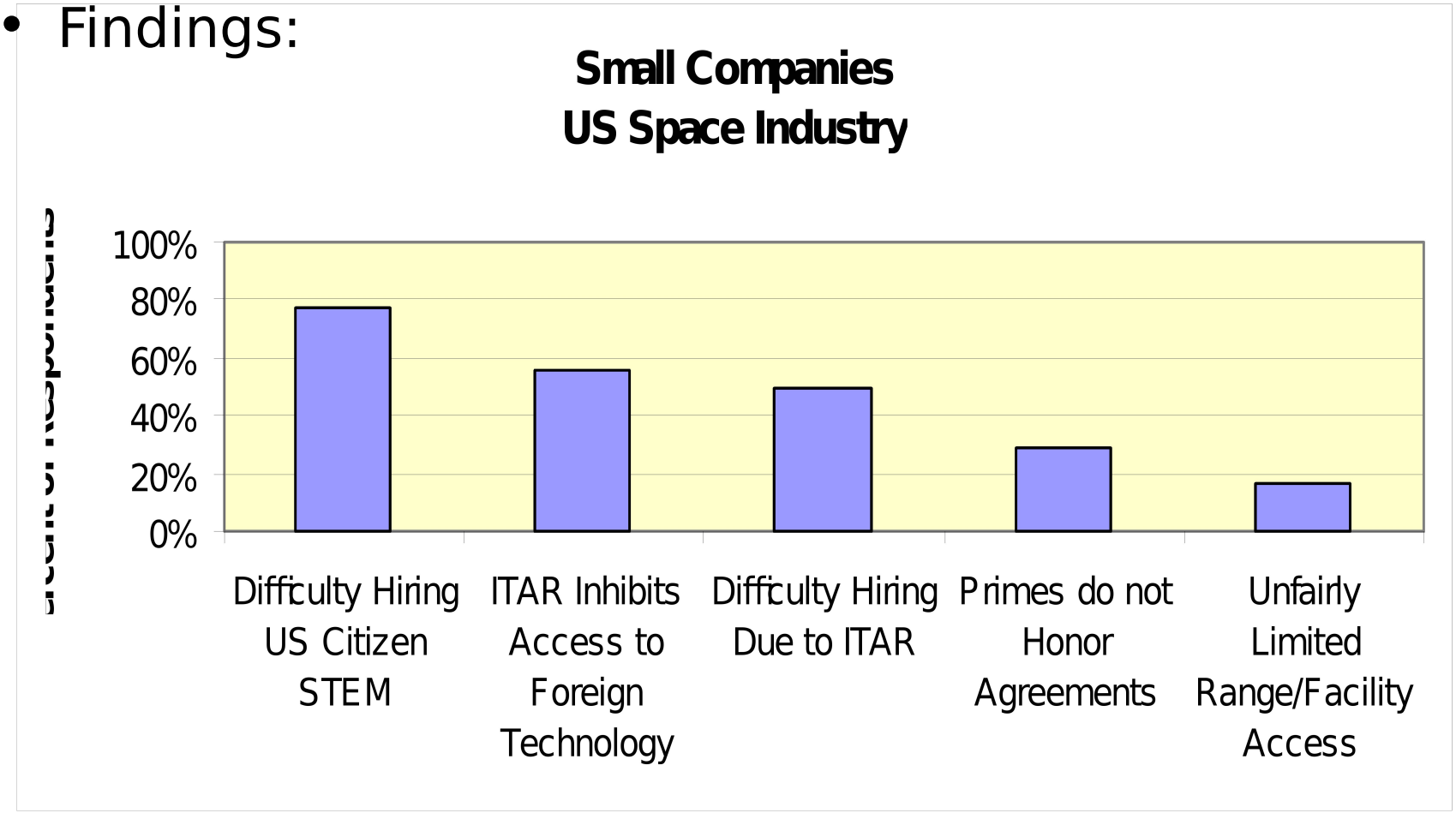
Findings and Recommendations:
Resource Impediment Barriers

- Findings:
  - Small companies
    - Receive lower fees as prime from Gov't
    - Receive lower fees as sub to larger companies
    - Encounter pricing/bundling restrictions which limits



Findings and Recommendations:
Resource Impediment Barriers

- Findings:



Findings and Recommendations:
Resource Impediment Barriers

- Findings
  - 58% of respondents perceive that DoD/IC policies and incentives for R&D have a negative impact on developing space technology products and services
  - In the Aerospace/EMAC interviews, two of the *top barriers to advancement and insertion of technology* are:
    - Recent risk averseness on including technology below TRL 6
      - De-emphasis on advancing technology on the part of Gov't inside programs
    - Customers are less willing to fund technology development.
      - No Gov't organization responsible for bridging from early technology development (TRL 2-3) to maturation (TRL 6-7) for insertion in space applications.

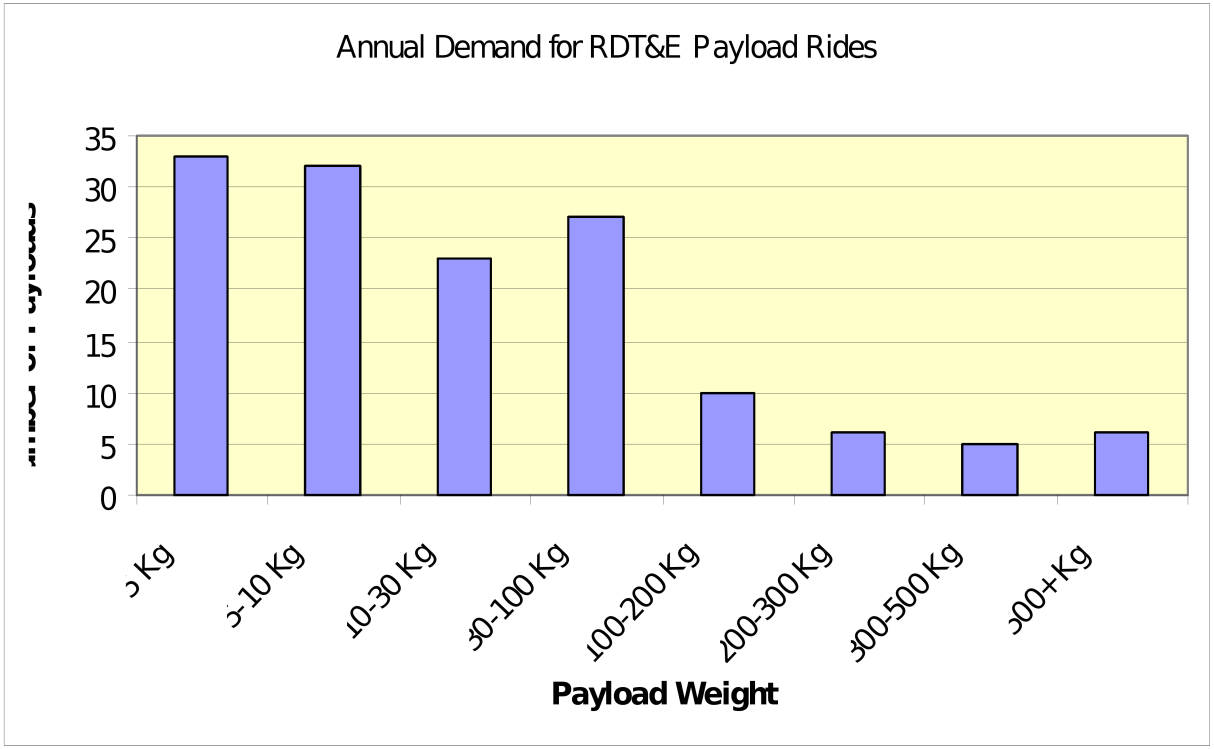
Findings and Recommendations:
Resource Impediment Barriers

- Findings cont'd
  - 70% perceive that they had inadequate opportunities to compete for R&D portions of contracts awarded to the primes
  - 26% indicated that 2 ½ years is not enough time to bring SBIR* technologies to TRL 6.
    - The average time suggested by the above was 47 months
    - 67 % indicated that $850,000 is not adequate to bring SBIR technologies to TRL 6.
    - The average amount suggested by the above was $2.6M.

***SBIR - Small Business Innovative Resear**

Findings and Recommendations:
Resource Impediment Barriers

- Findings cont'd
  - Unmet demand for RDT&E launch services for a variety of payload weights



Note: Estimating total demand would require additional data collection.

Findings and Recommendations:
Resource Impediment Barriers

- Respondent recommendations:
  - **M** – Allow a modestly higher fee range for smaller companies to offset higher cost of money
  - **E** – Require an annual report as a deliverable from primes to increase transparency
    - Pass-through business promised to subcontractors during pre-contract teaming vs actual awards to subcontractors
    - Copies to subcontractors who had teaming agreements
  - **E** – Require primes to deliver a subcontract technical management plan for flow of R&D tasks to subs

Findings and Recommendations:
Resource Impediments
Recommendations

- Respondent recommendations cont'd
  - Modify Small Business Innovative Research (SBIR) phase timing and funding limits to permit reaching TRL 6 for space systems:
    - Flexible (negotiated) SBIR Phase lengths exceeding 30 months
    - Flexible (negotiated) total SBIR project costs exceeding $850,000
  - No increase needed in SBIR funding level (R&D tax)
  - Explore ways for space industry to collaborate with academia and Gov't agencies on space related scholarships and internships for STEM
    - Determine critical skills
    - Facilitate use of existing STEM programs to assist with targeted critical skills
    - Track and adjust emphasis as needs are met

Findings and Recommendations: ***Resource Impediments Recommendations***

- Respondent recommendations cont'd
  - E – Provide clearinghouse for information on opportunities for flight testing components, subsystems
    - Vendor neutral information exchange web site

Types of responsible organizations: Small Business Administration, OSD/ATL, SPOs, DCAA, DCASMA, academia, state Governors' offices, Service and agency space system developers.

Conclusions

DoD/IC policies and practices interact with already challenging market conditions

– *Market Conditions*

- Complexity of operational environment
- High initial investment
- Economies of scale
- Learning curve
- Low production rates
- Switching costs are high
- Access to qualified labor
- Limited operational access for testing/repair/replacement/refuel
- Gov't is significant portion of US space market

– *DoD/IC Policies and Practices*

- Export restrictions
- Access to information on emerging concepts, new projects, requirements, plans
- Administrative restrictions and burdens
- Access to ranges, platforms and other facilities
- Cleared space professionals
- Contract bundling and pricing
- Payment delays
- Funding uncertainties
- Technology constraints

Conclusions CONT'D

- There are several suggestions to help level the playing field for small companies
  - Most can be remedied within current laws
  - Many can be remedied within current regulations
  - Most involve collaboration among multiple agencies
  - Some are inexpensive, some are more costly
  - Some would assist companies of any size/experience
  - Many impact the transparency of predictable productization, which impacts uncertainties of development and sales risk, which affects the availability of venture capital for small companies

Follow-up Actions

- Brief results to collaborating/coordinating organizations for comment
  - Understand full complexities of remedies
  - Refine recommendations
  - Advocate actions
- Brief to Space Industrial Base Council
- Assist organizations with collaboration and analysis

Feedback

- Comments or Questions?

- Contact Information

Alan Dunham

National Security Space Office

Alan.dunham.ctr@osd.mil

571-432-1426

BACKUP

Problem Rationale

- Barriers are created by US Gov't policies and practices as well as by economic ('market') conditions.
  - Gov't policies and practices should be studied to identify opportunities to influence the space industry economic environment. *
- Attracting new entrants and avoiding the unnecessary loss of existing participants is a matter not only of *fairness,* but of *maintaining pre-eminence* in space for National Defense.
  - National Space Policy goals are significantly dependent upon new approaches and technology innovation from the US private sector.
  - Over half of space R&D is internally funded by companies.**
  - R&D is a significant portion of the work of most lower tier companies in the US Space Industry.***

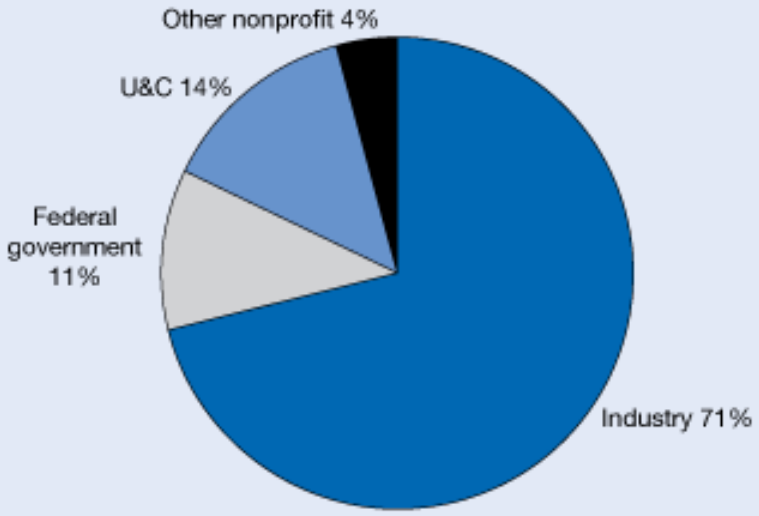
Lower tier companies are a significant source of technology innova

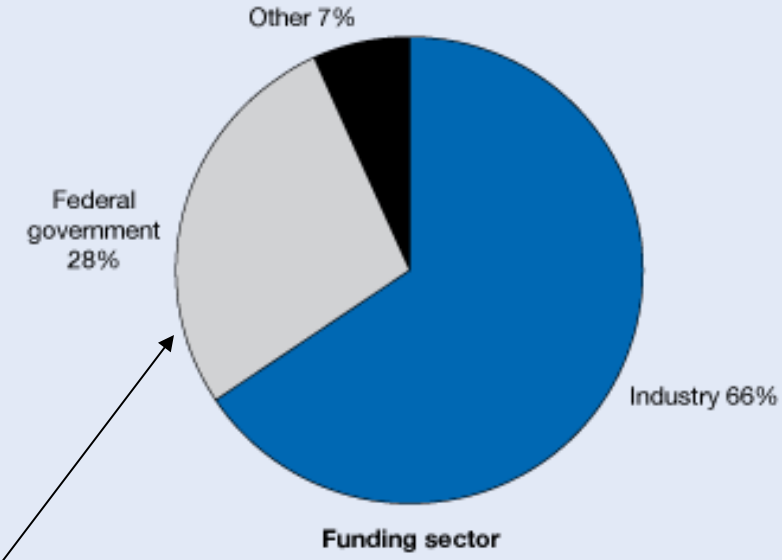
** Tasking from DASD/Strategic Capabilities, 14 Aug 07*
*** Defense Industrial Base Assessment: US Space Industry Final Report ,31 Aug 07, page 27, Fig 3.2-*
**** ibid, page 29, Fig 3.2-4*

Goals: Importance of Lower Tier Companies

Sources of All US R&D

Figure 4-2
Shares of national R&D expenditures, by performing and funding sectors: 2006





U&C = universities and colleges

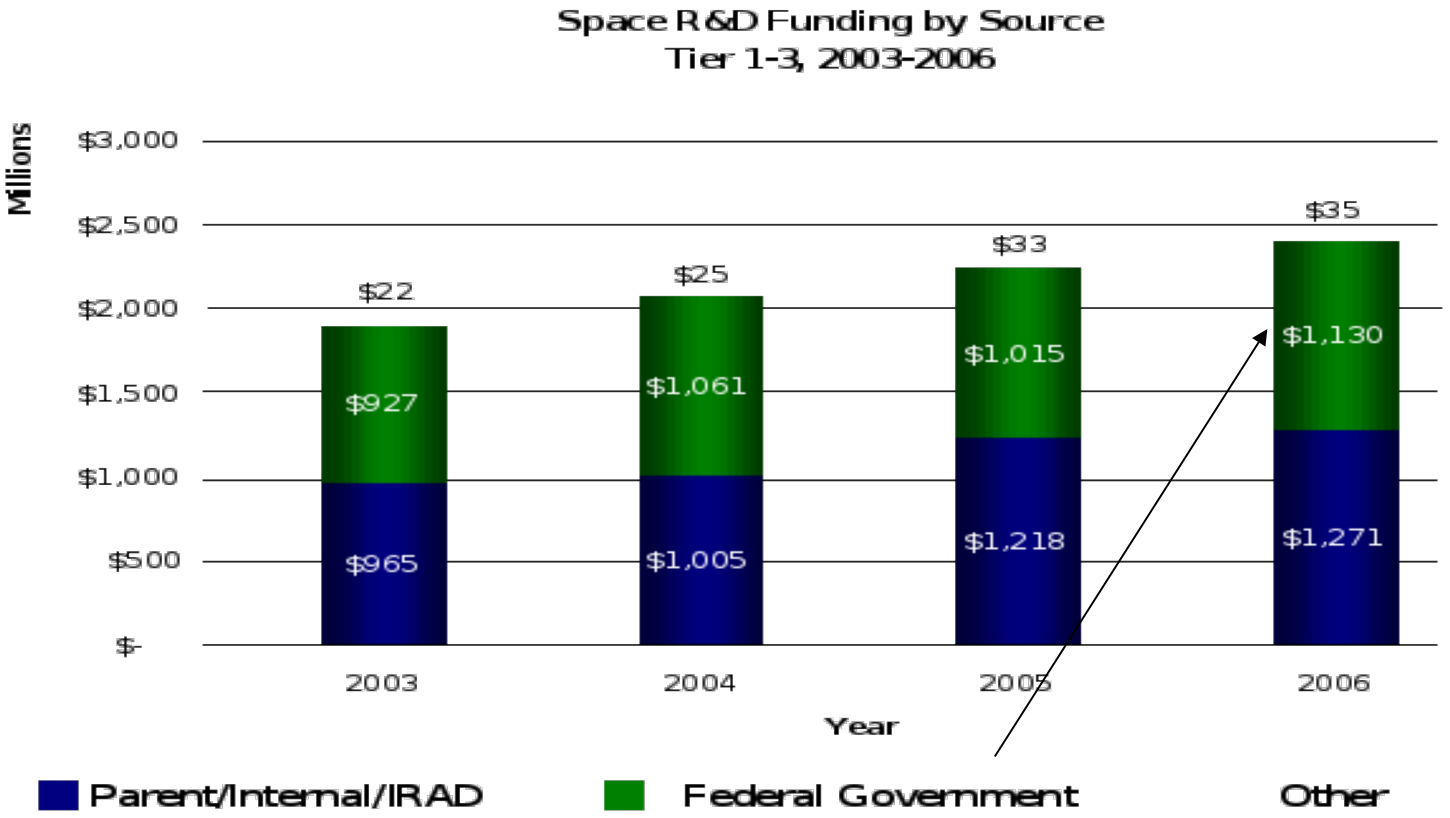
NOTES: National R&D expenditures projected at $340 billion in 2006. Federal performing sector includes federal agencies and federally funded research and development centers. Values rounded to nearest whole number.

SOURCE: National Science Foundation, Division of Science Resources Statistics, National Patterns of R&D Resources (annual series). See appendix tables 4-3 and 4-5.

Science and Engineering Indicators 2008

For US Industry as a whole, the Federal Government funded about 28% of R&D in 2006.

Goals: Importance of Lower Tier Companies
Space Industry R&D by Funding Source



For the US Space Industry, the Federal Government funded about 47% of Industry R&D in 2006, playing a much larger role than for US industry as a whole.

Source: Department of Commerce survey of Space Industrial

Goals: Importance of Lower Tier Companies
Comparison of US R&D as % of Sales

Example US Industry (1997)

Table III
Largest R&D-active U.S. companies

Rank in 1997	Company	$R&D (millions)	$R&D/ $sales (%)
1	General Motors	8,200.0	4.9
2	Ford Motor Company	6,327.0	4.1
3	IBM	4,307.0	5.2
4	Lucent Technologies	3,100.6	11.8
5	Hewlett-Packard	3,078.0	7.2
6	Motorola	2,748.0	8.6
7	Intel	2,347.0	9.4
8	Johnson & Johnson	2,140.0	9.5
9	Pfizer	1,928.0	15.4
10	Microsoft	1,925.0	16.9
⋮			
95	Imation	194.9	8.9
96	Dana	193.0	2.2
97	Thermo Electron	191.6	5.4
98	Eastman Chemical	191.0	4.1
99	Cabletron Systems	181.8	13.2
100	Whirlpool	181.0	2.1

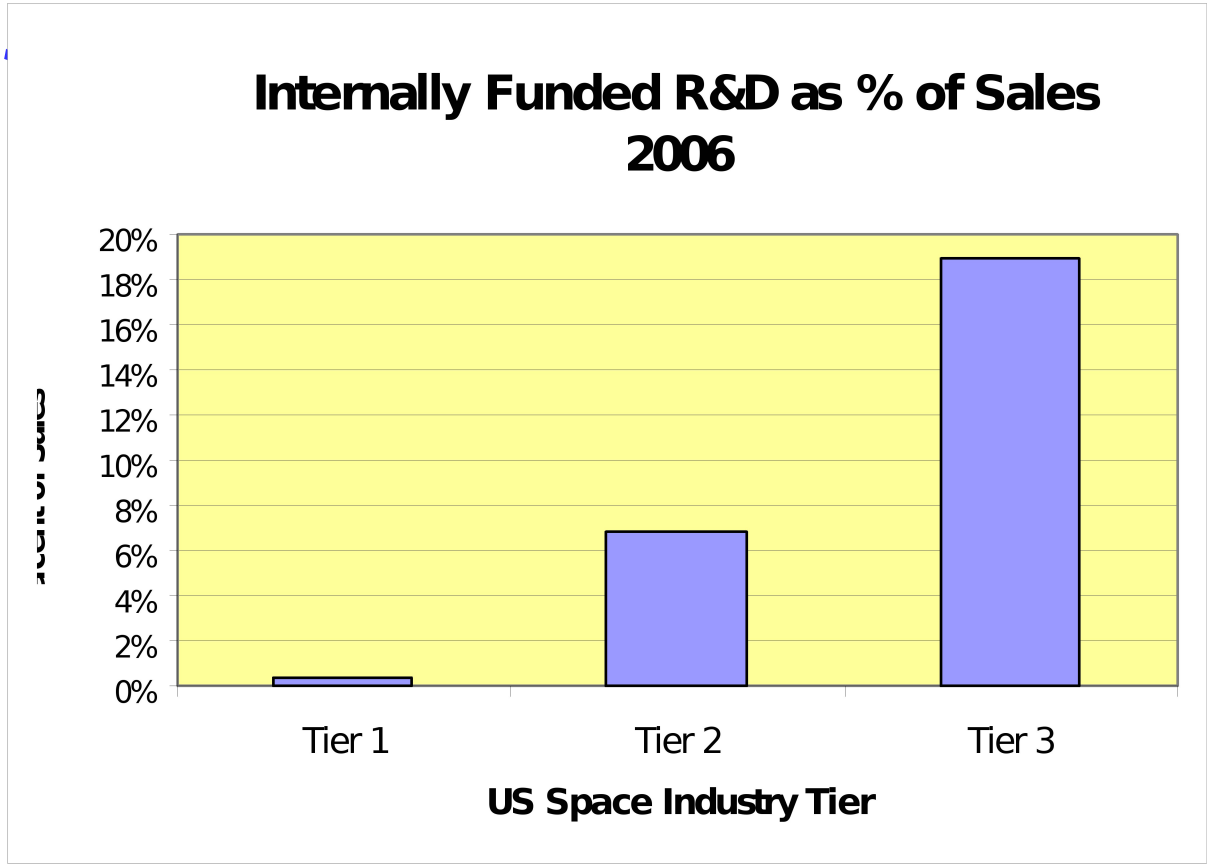
10 largest ompanies

Source: *Science & Engineering Indicators—2000*, Appendix Table 2-58.

For US Industry as a whole, internally funded R&D averaged over 8% of sales, with large companies expending 4.1% to

Goals: Importance of Lower Tier Companies

Comparison of US Space R&D as % of

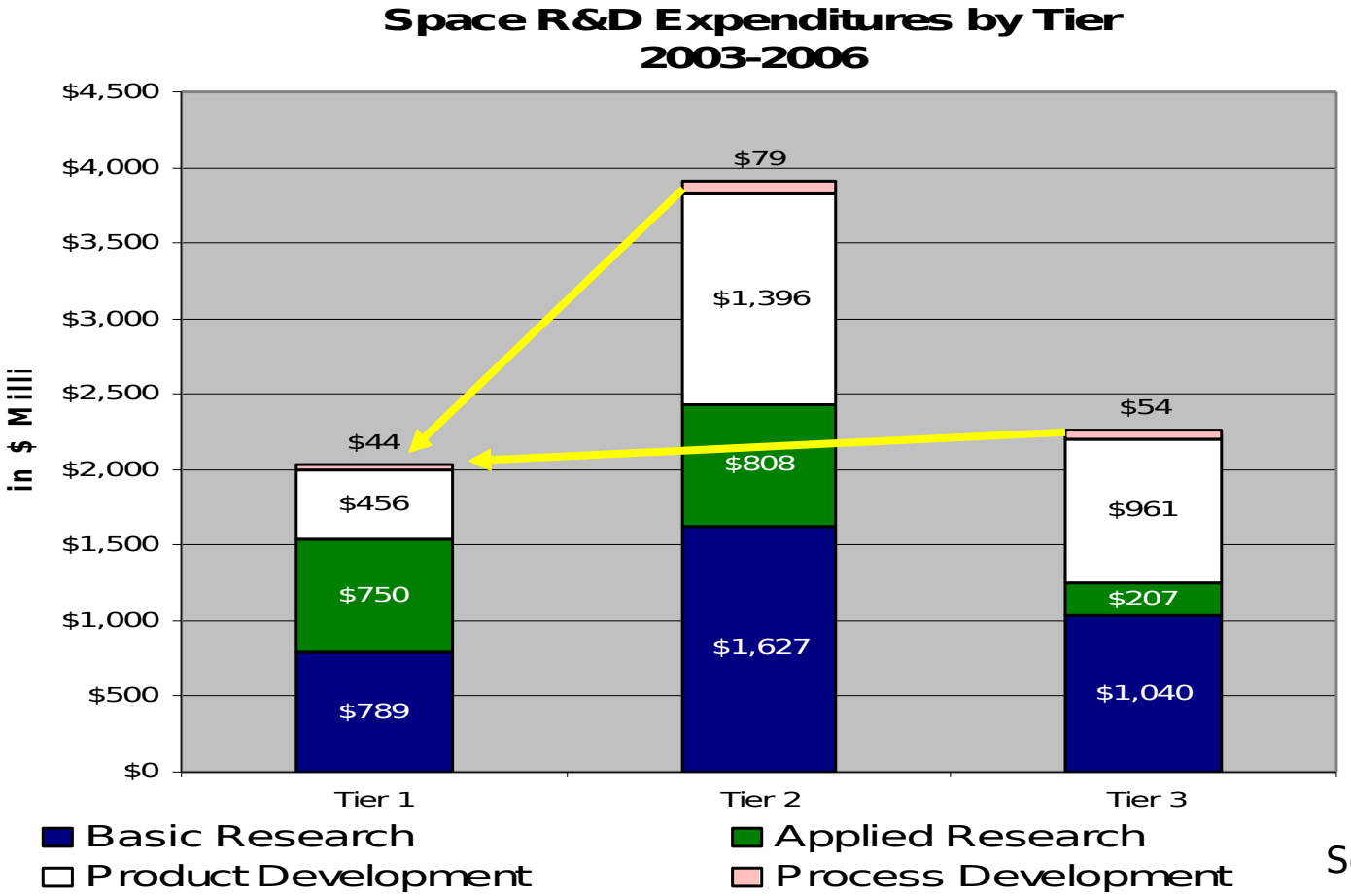


Source: DOC Survey

For US Space Industry, internally funded R&D is a much larger percentage of lower Tier sales

Tier 1- primes, Tier 2 – major subsystems, Tier 3 – specialty sub

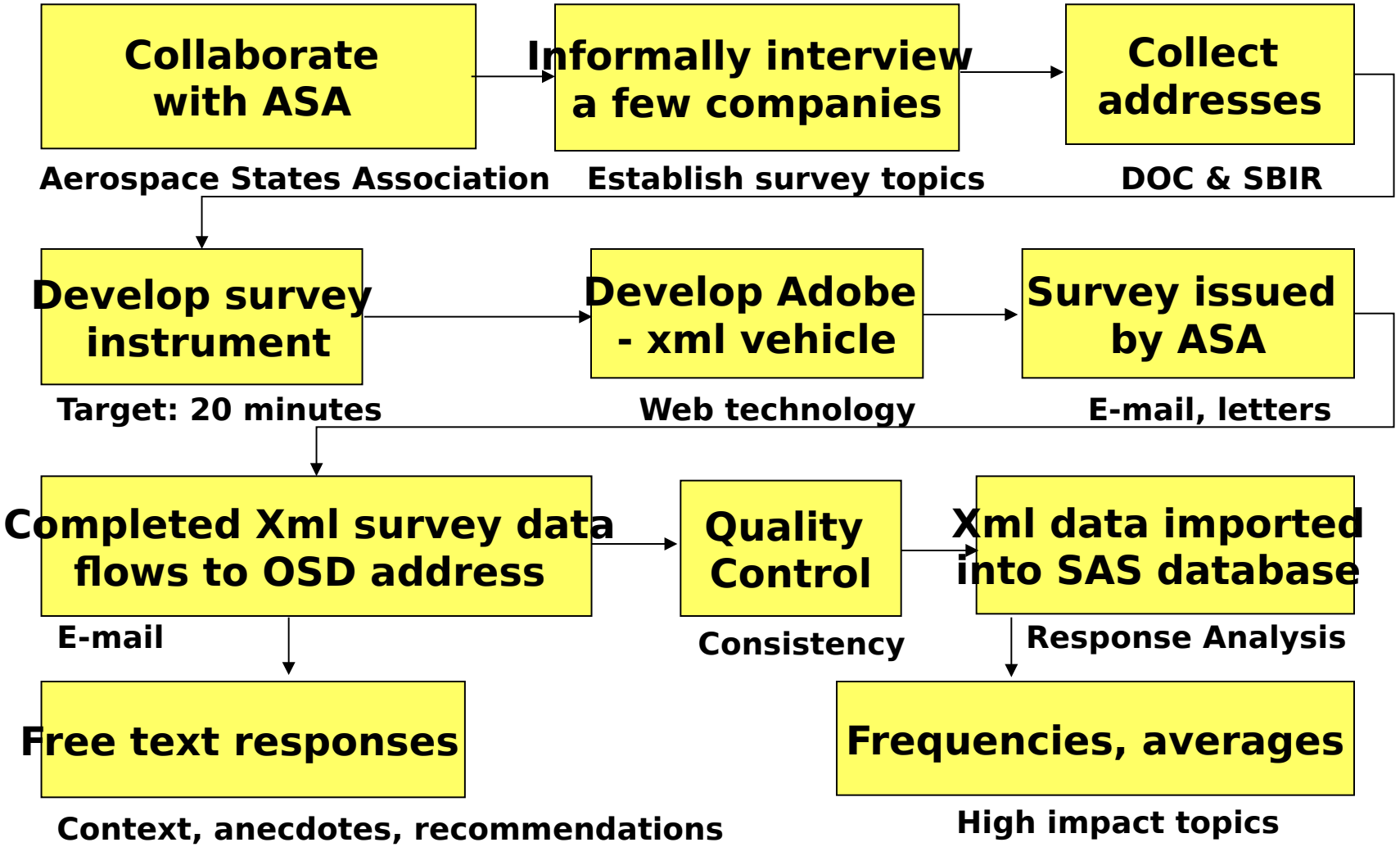
Goals: Importance of Lower Tier Companies
U.S. Space Industry R&D by Tier



Source: DOC Survey

Tier 2 & 3 companies *each* conduct more R&D than Tier 1 compan

Data Collection: Online Survey Process



Sample Size Needed to Identify Issues

- Assume a potential 'issue' for small company entry and sustainability in the US Space Industry is indicated by a proportion of 25%, which we call p
- Assume 'noise' indicating no issue is reflected by a proportion close to 0%
- In terms of sampling theory, the desired precision = .25-0 = .25, which we call e
- Using the normal distribution and a one-tailed statistic, Z for a 95% confidence = 1.645
- The desired sample (n) to achieve precision of .25 with 95% confidence is n = 4(z^2)(p)(q)/e^2 = 33*, where q = 1-p .
- We improve this estimate for a known finite population size of small companies in the space industry, N = 400

  n' = n /(1+ (n-1)/N) = 30.56>>>31*

- Thus, we need at least 31 survey responses to achieve the desired precision (25%) with 95% confidence. Our sample size is adequate.

*** Page 296, Devore, Jay L., Probability and Statistics for Engineering and the Sciences, Sixth Edition, 2004, Thomson Brooks/Cole, Belmont, California**